

**Lecture:**  
**- Einführung in Python zur Datenauswertung -**  
**- Introduction to Python for Data Analysis -**

**Summary:**

This lecture series is a comprehensive introduction to the programming language Python. It covers the most important Python features and functions that are required for the display and analysis of MR images and measurement data.

**Target audience and prerequisites:**

The lecture series is open to everybody who wants to learn about Python. Importantly, there are no prerequisites.

**Language:**

English or German, as requested by the audience.

**Place and Time:**

**In presence:** Seminar area of the Cooperative Brain Imaging Center (CoBIC), Heinrich-Hoffmann-Str. 9, Building 88, Campus Niederrad; Time: will be announced.

**Online** (if requested or if lectures in presence are not possible): Links will be sent to registered participants.

**Script:**

The lecture material can be made available to registered participants.

**Registration:**

Via E-Mail to Prof. Dr. Ralf Deichmann <Deichmann@med.uni-frankfurt.de>

**(see next pages for an overview of the lecture series)**

## Overview of the different parts:

### Part 1

1. Introduction: Python
2. The Python Interpreter
3. Python Lists
4. Python Tuples
5. Python Modules
6. Variables in Python:
  - Predefined variables in Numpy
  - Naming own variables
7. Numpy Arrays

### Part 2

1. Types of Numpy Arrays
2. Mathematical Numpy Array Operations:
  - 2a: Overview
  - 2b: Element-wise Operations
  - 2c: Matrix and Vector Algebra
3. Logical Operators and "numpy.where": Motivation
4. Logical Operators
5. The function "numpy.where"
6. Logical Operators and "numpy.where": Application

### Part 3

1. Data Types
2. Input Functions
3. Output Functions
4. if-Statements

### Part 4

1. Random Numbers
2. Histograms
3. Basic Statistical Functions
4. Defining Own Functions

## **Part 5**

0. Summary: Plot Types
1. Line Plots
2. Scatter Plots
3. Bar Charts
4. Pie Charts
6. Export Plots

## **Part 6**

1. Operations on 2D image data
  - 1a: Display via `matplotlib.pyplot.imshow`
  - 1b: Mirror image
  - 1c: Rotate image
  - 1d: Circular Shifts
2. Operations on 3D image data
  - 2a: Extract slices in different orientations
  - 2b: Display via `skimage.util.montage`
  - 2c: Permute dimensions: command `numpy.transpose`
3. A WARNING about image operations

## **Part 7**

1. for-Loops
2. while-Loops
3. Interrupting loops
4. Concatenating loops
5. String Lists and String Arrays
6. The module "os"

## **Part 8**

1. Sorting Numpy-Arrays:
  - Basics
  - Calculate percentiles
  - Sort with indexing
2. Working with text files:
  - General
  - Writing to text files
  - Reading from text files
3. Strings:
  - General commands

- Composing strings
  - Decomposing strings
4. The module "pathlib"

## **Part 9**

1. Linear Regressions:
  - Motivation and basic principles
  - The scipy function "stats.linregress"
  - Linearizations
2. Polynomial Regressions:
  - Using scipy's odr
3. Nonlinear Regressions:
  - Motivation and basic principles
  - Definition of functions in the interpreter
  - The function "curve\_fit" from scipy.optimize
  - Performing nonlinear regressions

## **Part 10**

1. Interpolations - 1D
  - 1a: Motivation and basic principles
  - 1b: Linear interpolation
  - 1c: Spline interpolation
2. Interpolations - 2D
  - 2a: 2D functions
  - 2b: Basics of 2D interpolation
  - 2c: Resampling 2D images
3. 3D-Plots of scalar fields
  - 3a: surface plots
  - 3b: contour plots
  - 3c: imshow
4. 3D-Plots of vector fields
  - 4a: quiver plots

## **Part 11 - under preparation**

Reading and Writing NIfTI files (planned)